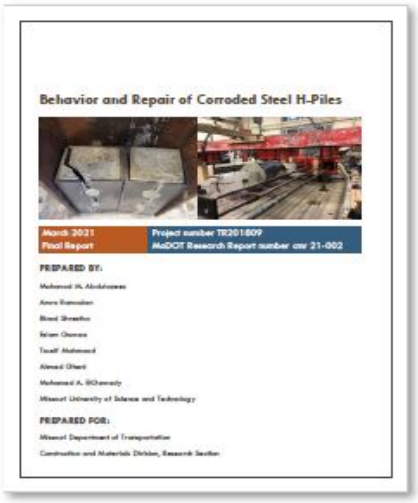
For more information contact: Jennifer Harper (573) 526-3636

Research Summary

Behavior and Repair of Corroded Steel H-Piles



This report summarizes the details of an experimental work and finite element modeling conducted to evaluate: 1) the remaining axial capacity of H-piles having different corrosion severity and extension levels, and 2) the performance of repaired corroded H-piles. The research included testing of nine piles under concentric loads and eight piles under eccentric loads.

Three different repair options were investigated. The first option included attaching concrete filled pultruded fiber reinforced polymer tubes to the corroded pile. The second option included attaching ultra-high performance concrete (UHPC) plates to the corroded piles. The third option included using concrete encased in fiber reinforced polymer (FRP) jackets.

The three solutions were first optimized using push-out testing of thirty-eight H-piles. This was followed by repairing nine full-scale piles and subjecting them to concentric axial loads. Different analytical approaches were implemented and examined to assess the ultimate strength of the corroded and repaired piles. This comprehensive research revealed that corrosion changed the mode of failure of the experimentally investigated piles from global buckling to flange or web local buckling.

The axial capacity of symmetrical and asymmetrical corroded piles remained the same. This occurred since the performance of both piles controlled by local buckling in the flanges. Therefore, introducing the asymmetrical corrosion did not affect that mode of buckling and hence did not affect the ultimate pile strength. Furthermore, decreasing the corroded length increased the experimentally investigated piles' axial capacity. Furthermore, eccentricity loading has a significant effect on the strength of corroded H-piles, especially in severe corrosion cases, which were idealized in this report using a reduction in the thickness of flanges and webs combined with cuts in the flange and voids in the webs.

"Different analytical approaches were implemented and examined to assess the ultimate strength of the corroded and repaired piles."

The AISC (P-Δ) was the best approach to predicting all corroded piles' ultimate strength subjected to concentric and eccentric axial loads. Specimens repaired using concrete jackets and UHPC plates were able to recover their virgin strengths. In addition, the UHPC plate solution is a versatile solution that can be used for rapid

repair. The concrete filled pultruded FRP tubes solution was not able to recover the strength of the repaired pile.

Figure 1: Large-scale Repaired H-pile After Testing

Project Information

PROJECT NAME: TR201809– Assessment and Repair of Corroded Steel H-Piles

PROJECT START/END DATE: December 2017-January 2021

PROJECT COST: $227,498

LEAD CONTRACTOR: Missouri University of Science and Technology

PRINCIPAL INVESTIGATOR: Mohamed ElGawady

REPORT NAME: Behavior and Repair of Corroded Steel H-Piles

REPORT NUMBER: cmr 21-002

REPORT DATE: March 2021

Project Manager

CONTACT INFORMATION:

Jennifer Harper
Research Director
Missouri Dept. of Transportation
1617 Missouri Blvd.
Jefferson City, MO 65109
(573) 526-3636
Jennifer.Harper@modot.mo.gov